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JOURNAL OF THE HYDRAULICS DIVISION

PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

DIVISION ACTIVITIES HYDRAULICS DIVISION

Proceedings of the American Society of Civil Engineers

NEWS

August, 1960

THE PURPOSE OF THE HYDRAULICS DIVISION

The advancement and dissemination of scientific and engineering knowledge in all branches of hydraulics, hydrology, hydraulic engineering and water resources. In particular this shall embrace meteorology and hydrology as the sciences dealing with the occurrence of water in the atmosphere, on the earth surface and in the ground, fluid mechanics for the understanding of all flow phenomena, applied hydraulics for the design and planning of hydraulic structures and of comprehensive systems, and those social, economic and administrative aspects basic to the conservation and utilization of water as an essential natural resource."

All committees and task forces together with their members are listed in Official Register for 1960.

Committee Activity

Hydraulics Division Research Committee

At its meeting in Washington, D. C., on April 25 and 26, 1960, the Research Committee of the Hydraulics Division discussed ways and means of stimulating interest in Civil Engineering Research. One important action favored by the Committee is to raise the annual dues of the Society about \$5 and to reallocate these additional funds for increasing research activities. Such serious action on the part of the Civil Engineering profession would indicate to the public and to prospective sponsors that research is important in the eyes of those most intimately acquainted with research needs. The effect of this would increase the availability of funds for research from both public and private sources.

The Committee discussed the problem of important unpublished data resting in files and how to get them published so they would become available for use of the profession at large. The Committee is very anxious to help individuals having data published, and invites anyone who has or knows of such

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information to communicate with the Research Committee. If a description of the material is furnished with publication plans, if any, the Committee will offer its suggestions for publication or will refer the individual to an appropriate technical committee for assistance in evaluating the data and for recommendations or presentation or publication.

The Committee on Research of the Hydraulics Division is preparing a line of eight typical basic research projects which may serve as examples of the kind of research which the committee feels should be undertaken by Civil Engineers.

The objective in preparing such material is to help people who have ideas for research to prepare proposals for research programs and to get financial support for them. It is the Committee's hope that these examples will help research workers to improve the presentation of their ideas so they will be accorded the best possible reception by prospective sponsors. Drafts of outlines of these projects are being readied for circulation to experts in fields covered for comments and suggestions. After revision they will be submitted to Civil Engineering for publication.

In undertaking this work the Research Committee is carrying out its assigned objective which in part is to initiate, organize, and coordinate programs of research in hydrology, hydromechanics and applied hydraulics, to promote interest in and financial support for research in cooperation with the societies Committee on Research.

The following memorandum will be of particular interest to members of the Hydraulics Division:

"A SURVEY OF HYDRAULIC RESEARCH WORK AND ACTIVITIES"

By R. D. Goodrich¹ and J. M. Robertson²

20 May 60

Following its reconstitution in 1957 as an administrative committee charged with the task of initiating, organizing, and coordinating hydraulic research, the Hydraulic Research Committee attempted to assess the hydraulic research activity and needs as currently visualized by the many committees of the Society. Since hydraulics not only includes certain application areas directly but also represents a subject basic to other fields encompassed in the work of several ASCE divisions, inquiries were directed both within and without the Hydraulics Division. The six technical committees of the Hydraulics Division and the research committees of the Engineering Mechanics (fluid Dynamics Comm.), Highway, Irrigation and Drainage, Pipeline, Sanitary Engineering, Soil Mechanics and Foundation (Comm. on Earth and Rockfill Dams) and Waterways and Harbors Divisions were asked the following questions:

1. What research programs are now in progress under the direction, sponsorship, or prodding of your committee? (Include literature review, research and the formulation of new concepts based on elements of existing knowledge, as well as laboratory or field studies.)
2. What research programs do you consider should be undertaken within the area of responsibility of your committee?

¹ Chairman 1958.

² Chairman 1959.

3. What plans do you have for getting the research programs you consider desirable underway?

Some very suggestive and pertinent information has been received, although some of the persons contacted took a narrow definition of research and ignored the parenthetical comments in Item 1. This memorandum attempts to summarize the ideas and information furnished. In line with the committee's responsibility to coordinate, this material should be given wide dissemination.

The survey of hydraulic research work has led to a picture of the research in hydraulics underway by or associated with the society, to some very valuable indications on how others are approaching the problems of promoting research in their areas, and to information on desirable hydraulics research projects. This summation on the information received will be presented in accord with this subdivision. In general the information on desirable projects came from the intra-divisional contacts but some came from the international contacts.

TE Engendered Hydraulics Research

With the exception of the work reported by the Sanitary Engineering Research Committee, few of the committees contacted felt that they had any research in progress. Reference, however, to the assignments of various task forces under these committees strongly suggests that indeed research is underway. Utilizing the information given in the 1959 ASCE Official Register, an attempt has been made to circumvent this narrow interpretation of research. Presentation of the research underway by the Sanitary Engineering Research Committee is not included here since it is not hydraulics in the strict connotation—it will be discussed briefly in the next section. Due to a lack of familiarity with the efforts of the other division, this present summary is limited to the Hydraulics Division. In all probability other task force activities should, however, be included in this listing, e.g., Task Committee on Mechanics of Stratified Flow (Fluid Dynamics Committee of Engineering Mechanics Division).

The following task forces of the various technical committees of the Hydraulics Division appear to be concerned with at least a certain amount of hydraulic research activity:

• Energy Dissipators for Spillways and Outlet Works	}	Hydraulic Structures Comm.
• Flow in Large Conduits		
• Hydrologic Data	}	Hydrology Comm.
• Spillway Design Floods		
• Aerated Flow in Open Channels	}	Hydromechanics Comm.
• Cavitation in Hydraulic Structures		
• Friction Factors in Open Channels	}	
• Local Scour		Sedimentation Comm.
• Sediment Distribution in Reservoirs		

All of these efforts fall into a certain class of research effort involving as a combination of literature research, compilation of available information in new forms, and encouraging interest in the several problems. These

are all desirable activities in important areas, however they do not represent all the hydraulics research that should be in progress.

Promotion of Research

A major problem facing this present committee is how to promote more the needed hydraulic research. Some very valuable suggestions in this regard have been obtained from three sources, two of these from the inter-divisional contact letters and one from a less formal extra-society contact. In 1956 the Hydraulics Division of the ASME organized a Fluid Mechanics Sub-committee to encourage work in fundamental fluid mechanics. This committee has already made much headway. They first conducted a survey of unsolved problems.* One topic which stood out was stall or flow separation and its associated transient effects. This conclusion led directly to the major effort holding two-day "stall symposium" at the ASME annual meeting in December 1958. Some 300 engineers attended, listened to formal presentations, gave informal comments and exchanged informal comments and information. It was obviously a valuable contribution to the research effort.

The committee on research of the Irrigation and Drainage Division has also followed a questionnaire approach. A response of about 53 per cent received on 230 individuals contacted. The nature of the replies received to the development of a list of 29 research studies needed urgently. Many of these will be included in the next section of this report. The Committee on Sanitary Engineering Research appears to have the most active program of research sponsorship underway of all those contacted within the ASCE. This committee has divided itself into seven separate sections pertaining to the various branches of sanitary engineering. Each section is headed by one an expert in his area, who is almost entirely on his own. The committee has taken two separate approaches to encouraging research. In the first, they attempted to locate, summarize and evaluate current research. This led to submission of 18 research reports, which have been or are being published. The second approach (1957-1958) was the instigation of one new research project in each of the seven areas. Of the four upon which specific information was received, the support obtained, as of the spring 1958, varied from a grant from the National Institute of Health to contacts with the USPHS and APW for possible funds.

Needed Hydraulics Research Studies

One of the obvious purposes of this present study was to obtain suggestions on hydraulic research work that is felt to be necessary. In this aspect the information received varied from ten complete research proposals (including estimated budget and time schedule) submitted by the Hydromechanics Committee as representative of the type of research worthy of support by the profession and the ASCE, to lists as obtained by the Research Committee of the Irrigation and Drainage Division. The various project studies needed were listed or summarized in accordance with the source submitting them. A number of apparently non-hydraulic research needs have been omitted. An attempt has been made to eliminate duplications.

* S. J. Kline and R. C. Dean "Unresolved Problems of Fluid Mechanics," Mechanical Engineering, Dec. 1958, pp. 54-55.

mechanics Committee—

Diffusion in Flow Through Porous Media.

Applications indicated in regard to mixing of waters of different quality or spread of pollution in a ground water basin.

Submerged Jet in a Flowing Stream (with and without density difference). Jet directed at an angle to main strain. Application in regard to discharge of sewage in river or ocean current or waste gas into wind.

Low Velocity Current Meter.

Needed for laboratory model investigations and field measurements of harbor currents, ground water movement, etc.

Compact diffusers of Large Area Ratio.

Application in sedimentation basins, desilting works, etc.

(Note: work by Kline and associates at Stanford, appears to have this well in hand for "two-dimensional" diffusers. JMR.)

Critical Tractive Force of Sediments.

Understanding of conditions under which sediments first start to move is fundamental to scour and erosion problems and sediment transportation problems.

Structure of Turbulence in Shear Flow.

Forces on Stilling Basin End Sills and Baffles.

Systematic research study needed to measure the force on these to give the hydraulic engineer suitable design tools.

Discharge Coefficients for Flow Over Low Spillway Crests.

Need to determine the discharge coefficient for flow over a properly shaped crest at less than design head, since low crests often used as controls for chute spillways and designed without regard to change in shape for appreciable approach velocities.

Tidal Phenomena in Estuaries and Bays.

Better understanding of tidal phenomena is needed; there is almost no experimental confirmation of basic tidal theories. This would be a systematic laboratory study of the separate effects of estuary geometry and boundary resistance for damped oscillating tides.

Withdrawal of Fluid from Systems with Density Gradients.

Application in the selective withdrawal of water from water having thermal (density) gradients, as for cooling water in steam power plants.

Spillway Design Research Needs.

Detailed outline of all facets of spillways with indications of research problems (some 70) prepared by F. B. Campbell, November, 1956.

draulics Structures—

Spreading of Jets on a Sloping Floor.

Wave Pressures on Spillway Crest Gates.

Losses at Bifurcations and Trifurcations (diverging flow) in Large Conduits.

Hydraulic Characteristics of Reverse Tainter Valves.

Generalized Equations for Discharge of Tainter Gates.

Allowable Irregularities in Hydraulic Surfaces which can be Tolerated without Producing Cavitation.

(Note: committee was evidently not aware of Navy sponsored work on this subject which has recently been reported (cf J. W. Holl, ASME paper 59-Hyd-12). Application of this to problems considered should be reviewed before further work is considered. JMR.)

Flood Control—

18. Runoff from Small Watersheds.
19. Methods of Computing Backwater Curves by Electronic Computing Machines.
20. Assembling Up-to-Date Information on Manning's n.
21. A Study of Correlation of Floods with Meteorological Events.

Hydrology—

22. Groundwater Studies, including movement of saline waters, analysis and interpretation of fluctuations, etc.
23. Peak Runoff Studies of Small Watersheds.
24. Extension of Current Procedure for Estimating Synthetic Unit Hydrographs.
25. Investigations of Cyclical Trends in Meteorologic and Hydrologic Phenomena.

Irrigation and Drainage Division—Committee on Research

26. Methods of Reducing Reservoir Evaporation.
27. Improved Techniques for Recharging Aquifers.
28. Development of Design or Arrangement Criteria for Diversion Dams and Headgates to Reduce Sediment Entry.
29. Development of Simple Design Criteria for Roughness in Lined and Unlined Channels.
30. Hydraulics of Surface Methods of Irrigation.
31. Development of Improved Methods for Measuring Irrigation Intake Rates.
32. Development of Design Criteria for Open-Drain Bank Stabilization.
33. Development of Accurate, Low Cost Means for Measurement of Flows in Channels.
34. Criteria for Design of Stable Channels.
35. Criteria for Designer of Excluders and Ejectors for Sediment Control.
36. Laboratory and Field Studies of Weather Control.

Waterways and Harbors Division—Committee on Research

Suggested list of Research Problems Related to Waterways and Harbors Appropriate for Study in Smaller Private Laboratories.

37. Stream Channel Problems—Flood Channel Deterioration.
Model scale study of factors causing meanders, etc.
38. Stream Channel Problems—Bank Erosion by Wave Action.
Besides mechanism of erosion processes, need information on wave character from ships, small boats and local winds.
39. Sediment Supply to Shorelines by Streams.
40. Movement of Sediment by Wave Action.
41. Mechanics of Sediment Transport in Littoral Zone.
42. Characteristics of Waves Occurring.

43. Standing Waves and Seiches (Harbor Surging).
44. Dynamic Wave Forces.
Type of force, structure and characteristics of structure.
45. Ship Waves in Shallow Water.
46. Wind Tides.
47. Functional Design Methods for Shore protection Structures Jetties, Breakwaters, Groins, Bulkheads, etc.
48. Erosion and Scour of Pier Foundations.
49. Sources of Estuarine Sediments.
50. Salt Water Intrusion and Salt Water Wedge Phenomena.
51. Better Sediment Sampler for Use in Estuaries.
52. Improved Current Meter.
More sensitive and indicate direction as well as current.

The above list of research needs is far from complete and the committee should continue to devote its major attention to extending and improving the list. However, the committee feels that the important job to be done is to stimulate research into these important problems and that the mere collection of lists of needed research is of little value in itself unless some action is taken. Years ago the old Hydraulics Research Committee compiled a carefully considered list of needed research. Reference to that list indicates little progress toward really solving any of the problems. This committee could add more items to the list. What is more important, however, is to note which of the problems appears again and again in various lists—i.e., which are of paramount importance, such as in the case of stall for the ASME Hydraulic Division Sub-committee on Fluid Mechanics. When a few such problems, in their fundamental or basic aspects, are singled out then strenuous efforts should be applied to getting them researched. This is roughly the procedure of the Sanitary Engineering Research Committee. A good start toward a list of a few fundamental problems has been furnished by the Hydromechanics Committee."

Members Active in International Meeting

The 12 General Assembly of the International Union of Geodesy and Geophysics was held in Helsinki, Finland, on July 25 to August 6, 1960. Some 45 papers on hydrology were presented by American authors in the sessions of the International Association of Scientific Hydrology. ASCE was well represented with nearly one-third of the hydrology papers being authored by Society members. Following is a list of ASCE members participating and their papers:

1. Lindner, C. P., "Currents in Tidal Reaches of Rivers and Their Effect on Shoaling of Side Basins."
2. Linsley, R. K., Jr. (with Crawford, N. H.), "Computation of a Synthetic Streamflow Record on a Digital Computer."
3. Langbein, W. B., "Water Levels as Indicators of Long-Term Precipitation and Runoff."
4. Walton, W. C. (with Neill, J. C.), "Analyzing Ground Water Problems with Mathematical Models and a Digital Computer."
5. Rorabaugh, M. I., "Use of Water Levels in Estimating Aquifer Constants in a Finite Aquifer."

6. Simpson, E. S. (with Lieberman, J. A.), "Practices and Problems in Disposal of Radioactive Wastes into the Ground."
7. Henry, H. R., "Salt Intrusion into Coastal Aquifers."
8. Todd, D. K., "Salt Water Intrusion of Coastal Aquifers in the United States."
9. Snyder, F. F., "Evaporation on the Great Lakes."
10. Maddock, Thomas, Jr., "Erosion Control on Five Mile Creek, Wyoming."
11. Peterson, H. V. (with Hadley, R. F.), "Effectiveness of Erosion Abatement Practices on Semiarid Rangelands in Western United States."
12. Light, Phillip, "Snow Melt Floods, Spring 1959, Upper Mississippi Watershed."
13. Case, J. B., "Glacier-Mapping Activities in the United States."

Newsletter Read?

The Editor has wondered many times concerning the interest of the members in Newsletter items. Carl Kindsvater reports that he has already received a hundred requests for his draft on weir standards noted in the April 1960 issue of the Newsletter. These requests have come from hydraulics men in many parts of the world. It is encouraging to your Editor to know that the Newsletter is read by so many.

BOSTON ASCE CONVENTION

October 10-14, 1960

The Boston area should have its interesting fall characteristics on display. Plan to attend this meeting and enjoy the historical sights, East Coast beauty, and the five interesting sessions of the Hydraulics Division.

One of the many interesting social activities will be the Open House at the Hydrodynamics Laboratory, Department of Civil Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, Tuesday, October 11, 1960, from 8 to 9:30 p.m.

Technical Program

Session on Tidal Hydraulics:

Presiding: Arthur T. Ippen, Chairman, Executive Committee; and Raymond Boucher, Member, Tidal Hydraulics Committee.

Estuarial Sediment Transport Patterns

H. A. Einstein, Professor of Hydraulic Engineering, Department of Civil Engineering, University of California, and R. B. Krone, Assistant Research Engineer, Sanitary Engineering Research Laboratory, University of California, Berkeley, California.

The Analysis of Salinity Intrusions in Well Mixed Tidal Estuaries

Arthur T. Ippen, Professor of Hydraulics, Massachusetts Institute of Technology, and D. R. F. Harleman, Associate Professor of Hydraulics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Experimental Results on Salinity Intrusions in Estuaries

Henry B. Simmonds, Chief, Estuaries Section, Waterways Experiment Station, Corps of Engineers, Vicksburg, Mississippi.

The Tide in the St. Lawrence River

H. A. Neu, Hydraulics Laboratory, Division of Mechanical Engineering,
National Research Council, Ottawa, Ontario, Canada.

sion on Hydrology:

esiding: Arthur T. Ippen, Chairman, Executive Committee; and a member
of the Hydrology Committee.

Estimating Potential Evapotranspiration

W. Russell Hamon, Research Associate, Travelers Insurance Co., Hartford, Connecticut.

Use of High Speed Analog Computer for Routing of Storm Rainfall Through
a River Basin

Henry M. Paynter, Assoc. Prof. of Mechanical Engineering, Mass. Institute
of Technology, Cambridge, Massachusetts.

Infiltration of Fluids in Dry Porous Media

A. I. Johnson and W. N. Palmquist, Hydrologic Laboratory, U. S. Geological Survey, Denver, Colorado.

Use of Digital Computers in Computing Flow Hydrographs from a Network
of Sub-Areas

W. L. Northrop and C. W. Timberman, Corps of Engineers, Kansas City
District, Kansas City, Missouri.

sion on Sedimentation:

esiding: Arthur T. Ippen, Chairman, Executive Committee; and Robert B.
Banks, Member, Sedimentation Comm.

Research Needs in Sedimentation

H. A. Einstein, Professor of Hydraulic Engineering, Department of Civil
Engineering, University of California, Berkeley, California.

Effect of Bridge Constrictions on Scour

J. K. Liu, Assist. Prof., Colorado State University, Fort Collins, Colorado, and F. M. Chang, Research Assistant, Colorado State University, Fort Collins, Colorado.

Sediment Distribution in SCS Flood Water Retarding Structures

I. G. Heinemann, Hydr. Engr., Soil and Water Conservation Research Division, ARS, Lincoln, Nebraska.

The Mechanics of Washout of an Erodible Fuse Plug

C. Roy Tinney, Head, R. L. Albrook Hydraulic Laboratory, Washington State University, Pullman, Washington, and H. Y. Hsu, International Engineering Co., San Francisco, California.

sion on Hydromechanics:

esiding: Arthur T. Ippen, Chairman, Executive Committee; and a member
of the Hydromechanics Committee.

Anisotropic Turbulence and Wall Effects in Open Channel Flow

Paul G. Mayer, Associate Professor of Civil Engineering, Georgia Institute
of Technology, Atlanta, Georgia.

The Flow of Sand-Water Mixtures in Horizontal Pipes

Dr. Norbert L. Ackermann, Professor of Civil Engineering, University of Khartoum, Sudan, Africa, and Thomas E. Stelson, Head, Department of Civil Engineering, Carnegie Institute of Technology, Pittsburgh, Pennsylvania.

Effect of Roughness, Spacing in Rigid Open Channels

William W. Sayre, Assistant Civil Engineer, Department of Civil Engineering, and Maurice L. Albertson, Director, Research Foundation, Colorado State University, Fort Collins, Colorado.

Session on Hydraulic Structures:

Presiding: Arthur T. Ippen, Chairman, Executive Committee; and H. J. Tracy, Hydr. Engr., USGS, Atlanta, Georgia.

The Effect of Spur Dikes on Flood Flows through Bridge Constrictions

John B. Herbich, Department of Civil Engineering, Lehigh University, Bethlehem, Pennsylvania.

Hydraulics of River Flow under Arch Bridges

J. W. Delleur, School of Civil Engineering, Purdue University.

Flow Through Multi-Opening Constrictions

John Shen, U. S. Geological Survey, Washington, D. C.

Note on the Ninth IAHR Convention

The subjects for this convention which will be held September 3-7, 1960 have been chosen. They are as follows:

1. The effect of turbulence on hydraulic structures.
2. Mechanics of ground water flow.
3. Hydraulic problems for computers.
4. Modifications of natural streams by engineering structures.

In addition, there will be two seminars:

1. Hydraulics of small structures in irrigation and drainage.
2. Fundamental hydrodynamics of free surface flow and of unsteady flow.

For Your CalendarASCE Meetings

October 10-14, 1960

ASCE, Boston Convention

April 10-14, 1961

ASCE, Phoenix Convention

August 16-18, 1961

Hydraulics Division Conference,
Urbana, Illinois

October 16-20, 1961

ASCE, New York Convention

February 1962

ASCE, Houston Convention

May 1962

ASCE, Omaha Convention

October 15-19, 1962

ASCE, Detroit Convention

-ASCE Meetings

September 1960	Hydraulic Turbine Research Symposium, IAHR, Nice, France
September 5-10, 1960	Conference on Hydraulics (River Hydraulics and Hydraulics of Infiltration) Hungarian Academy of Sciences, Budapest, Hungary
October 29-November 2, 1960	Annual Meeting Geological Society of America, Division of Engineering Geology, Denver, Colorado
June 26-July 2, 1961	Seventh Congress International Committee on Large Dams, Rome, Italy
September 3-7, 1961	Ninth IAHR Convention, Belgrade, Yugoslavia
September 6-8, 1961	Seventh Midwestern Conference on Fluid Mechanics and Soil Mechanics, Michigan State University, East Lansing, Michigan
June 18-21, 1962	Fourth National Congress of Applied Mechanics, University of California, Berkeley, California

Use of the Hydraulics Division Newsletter

You are urged to continue use of the Division Newsletter for announcements, inquiries, personnel news, committee reports, surveys and other items of interest to Division members. A short note summarizing the highlights of committee meetings is particularly requested. Suggestions for improvement of the Newsletter will be appreciated. All contributions are appreciated.

Deadline dates for Newsletter contributions: October 1960 issue—August December 1960 issue—October 20.

COMBINED INDEX TO ASCE PUBLICATIONS

For complete coverage of the Society's 1959 year in print, there is now a Combined Index covering the Division Journals, Transactions, and Civil Engineering. Also included are reprints of the Proceedings Abstracts that are issued each month in Civil Engineering. The price of the Combined Index

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August,

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